USING LABORATORY PARAMETERS TO PREDICT

THE SURVIVAL OF COWS WITH RIGHT DISPLACED ABOMASUM

IS NOT ECONOMICALLY JUSTIFIED

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Right sided abomasal displacement and volvulus are common in dairy cattle. Recently, models have been developed to predict the post-surgical survival with accuracy near 80%. These models have been based on logistic regression, a powerful analytic technique for investigating categorical data. The objective of this study was to compare these models to the common decision to operate every cow, and to compute the expected economic gain from each alternative.

MATERIALS AND METHODS

Data were compiled from the medical records of all cows ($\geq$ 2 years old) admitted to the New York State College of Veterinary Medicine from 1980 to 1988 which had a final diagnosis of right abomasal displacement or volvulus. Cows with complete records for those variables previously determined to predict outcome (heart rate, base excess, and plasma chloride) were included (n=340). Three classifications for outcome (productive, salvaged, or terminal) were determined as described previously.

Local prices were used as estimates for the value of productive and salvaged cows. Current hospital averages were used to estimate the cost of the surgical procedure. The current clinical pathology fees were used to estimate the costs of laboratory tests. For each estimate, a range was used so that the sensitivity of the conclusions could be evaluated.

For each decision, the total gains and losses were calculated based on the following assumptions. Laboratory costs were charged if necessary to determine a decision whether to operate or ship the cow, and operative costs (OC) were charged if surgery was elected. Operated cows which returned to production were valued as productive (V_p), cows that were operated but later salvaged were valued as salvaged (V_s), and operated cows which were terminal were valued at zero (V_t). We assumed that the majority (P_{no}, 95%) of the non-operated cows would have received salvage prices, so these cows were valued at $P_{no}*V_s$.

Four models (or options) were considered. The first was a hypothetical model of perfect information which assumed that only productive cows were operated, and all others were shipped for salvage immediately. This represented the optimal decision, however unlikely it was to exist. The second model involved the common practice of

operating every cow, which was the actual method used to collect these data. The third model based the decision to operate on the parameters from the logistic regression analysis. The decision rule for the fourth model relied only the heart rate determined by physical examination.

The laboratory data model (logistic regression model) described previously provided two probabilities: the probability of productive (P_p), and the probability of salvage (P_s). The probability of terminal (P_t) was obtained by subtraction from unity. The decision to operate was made when the left side exceeded the right side of the following formula:

$$P_p (V_p - OC) + P_s (V_s - OC) + P_t (V_t - OC) \geq P_{no} V_s$$

The heart rate model selected surgery when the initial heart rate was below a certain threshold, else the cow was shipped for salvage. The threshold heart rate was determined by selecting the heart rate which provided the optimal economic return based on the estimates of the values of the different outcomes, and the actual heart rates and outcomes of the cows in this data set.

For each model, the total costs and returns were calculated for these 340 cows. Also, the sensitivity and specificity were calculated for each decision. Finally, minimal laboratory costs were calculated which would allow the laboratory model to be comparable to the decision to operate every cow.

RESULTS

The decision based on laboratory data provided greater economic returns than the decision to operate every cow. However, the return was less than the cost of obtaining the laboratory values. Thus, the net return was negative. The decision based solely on heart rate was also better than the decision to operate every cow, but using heart rate alone did not select cows as well as the complete model. However, the difference was less than the laboratory costs, so the heart rate model resulted in a greater net financial return than both the laboratory model and the operate every cow model.

The laboratory model was economically poorer than the decision to operate every cow, until the cost of electrolytes and blood gases was less than $18. The laboratory model was also economically worse than the decision based on heart rate alone until the cost of the additional lab work was less than $8.

The optimal heart rate for this data set and these assumptions was 125 bpm. This model predicts that cows with faster heart rates should be salvaged without surgery, and that surgery should be attempted on the other cows.

DISCUSSION

Most cattle with right displaced abomasum or volvulus are diagnosed by ambulatory clinicians, where laboratory results are not usually available. The results of this analysis demonstrate that the lack of such facilities does not affect the financial outcome. Furthermore, it demonstrates that a physical examination provides substantial information on which to base a rational, economically justified decision. Even though additional laboratory values increase the accuracy (sensitivity and specificity) of the evaluation, the additional expense of the laboratory evaluation is not economically warranted.

Dairy medicine is ideally suited to economic analysis, since most clients are interested in maximizing profit. However, many academic clinicians may be opposed to eliminating laboratory evaluations from their workups of these cows. There are both teaching and research reasons which can easily justify the continued use of a complete patient data base. However, this analysis shows that it is not in the clients direct interest to support such endeavors, and thus funding for these unnecessary laboratory tests should be procured from other sources.

Table 1: Economic Comparisons of Four Decision Models

Model	Perfect Decision	Always Operate	Lab Data	Heart Rate
V_p	1500	1500	1500	1500
V_s	500	500	500	500
OR Cost	250	250	250	250
Sensitivity	100%	0	20%	15%
Specificity	100%	100%	99%	99%
Average Return	$1029	$918	$936	$928
Vs Surgery	$111	-	$18	$10
Lab Cost	0	0	$25	0

REFERENCES

Gröhn YT, Fubini SL, Smith DL. 1990. Use of a multiple logistic regression model to determine prognosis of dairy cows with right displacement of the abomasum or abomasal volvulus. Am J Vet Res, 51:1895-1899.